RESEARCH

Evaluation of laminate veneer preparation depth with 3D systems

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ABSTRACT

Evaluation of laminate veneer preparation depth with 3D systems

Background: Preparation depth of laminate veneers are essential in retention and structural integrity of restorations. The aim of this study was to evaluate the difference between a trained professional prosthodontist (PP) and a postgraduate prosthodontics student (PPS) in the preparation depth of laminate veneers by scanning the tooth with a 3D scanner before and after the preparation.

Methods: Twenty extracted human maxillary central incisors were evaluated by a PP and PPS. A 0.5 mm depth guide bur was used in for facial reduction and a 1 mm incisal reduction was performed with a deep chamfer. The teeth were scanned with a laser scanner at an accuracy of 10 μm. The teeth were separated into 3 parts (incisal, middle and cervical) and then 5 points were randomly selected on the unprepared tooth and then lapped over when the preparation had been completed. The data of the difference was calculated in 3D scanning software Magics (Materialise NV, Belgium). Statistical analysis were performed with one-way ANOVA ($p < 0.05$).

Results: PP results showed mean values in the Incisal of 0.328±0.045 mm, Middle of 0.375±0.097 mm and Cervical of 0.471±0.07 mm. PPS results showed mean values in the Incisal of 0.323±0.056 mm, Middle results of 0.403±0.083 mm and Cervical results of 0.462±0.075 mm.

Conclusion: These results suggest that a PP or a PPS can both achieve the same precision in the preparation using a depth guide bur.

KEYWORDS

3D scanning, ceramic laminate veneer preperation, depth guide bur

ÖZ

Lamina veneer preparasyon derinliklerinin 3B sistemler ile değerlendirilmesi

Amaç: Lamina veneer restorasyonlarında preparasyon derinliği, yapısal sağlamlığın ve tutuculuğun sağlanmasında temel faktörlerin başında gelir. Bu çalışmanın amacı, deneyimli bir prostodontist (PP) ve yüksek lisans protodonti öğrencisinin (PPS) lamina preparasyon derinliklerinin, preparasyon öncesinde ve sonrasında 3B tarayıcı ile farklılıklarının değerlendirilmesidir.

Gereç ve yöntemler: PP ve PPS 20 adet çekilmiş insan maksiller santral kesiciyi değerlendirmiştir. Fasiyel preparasyon için 0,5 mm'lik derinlik rehberli frez kullanılmıştır. İnsizal preparasyon için ise 1 mm'lik champher frez kullanılmıştır. Dişler, 10 μm hassasiyetinde lazer tarayıcı ile taranmıştır. Dişler 3 kısıma (insizal, orta ve servikal) bölünmüş ve 5 noktadan incelenmiştir. Preparasyon yapılmamış ve yapılmış dişler üst üste çakıştırılarak Magics (Materialise NV, Belgium) 3B tarama yazılımında aralarındaki farklar incelenmiştir. İstatistiksel analiz tek yünlü ANOVA ile yapılmıştır ($p < 0.05$).

Bulgular: PP sonuçları ortalama insizalde 0.328±0.045 mm, ortada 0.375±0.097 mm, servikalde ise 0.471±0.07 mm olurken, PPS sonuçları ortalama insizalde 0.323±0.056 mm, ortada 0.403±0.083 mm ve servikalde 0.462±0.075 mm olarak bulunmuştur.

Sonuç: Bu sonuçlar, derinlik belirleyici frez kullanıldığında PP ve PPS benzer preparasyon hassasiyet gösterdiğini belirtmektedir.

ANAHTAR KELİMELER

3B tarama, seramik lamina veneer preparasyonu, derinlik belirleyici frez

As cosmetic dentistry's popularity increases exponentially, patients have started to visit dentists for more esthetically proportional anterior teeth. That matters being considered making healthy teeth look even better has become an area of interest in the dental community. The rapid improvement in dental ceramics and luting techniques has made even the most challenging restorative procedures possible.[1] The planned treatment has to be harmonious with the soft and hard tissue as well as aesthetic and functional. The developments in the last 20 years have made it possible for the tooth surface not to be prepared completely. Roughened porcelain layers luted on to the front portion of the tooth to improve aesthetics have made it possible not to prepare the whole tooth. After a long period, ceramic veneers have become an irreplaceable component of aesthetic.[2] Indirect ceramic veneer preparations are done to improve natural tooth aesthetics, they are done in laboratories beforehand and the outcomes can be seen before they are luted. This in return gives the opportunity to not prepare excessive tooth structure.[3] Ceramic laminate restorations are a

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suitable conservative treatment option in cases such as; malpositioned, discolored, traumatized or fractured anterior dentition.[4] This restoration type restores the lost esthetical properties therefore is becoming more popular day by day.[5]

The veneering concept was first described in the dental literature a long time ago, although it is only with the arrival of efficient bonding of resins to enamel and dentine and the use of etched porcelain surfaces that aesthetical, successful and strong restorations are made possible. Alternative veneering materials are still available, usually either direct or indirect composite resin materials. However, these may suffer from degradation of surface features and increases of surface stain in time. Porcelain veneers were traditionally made from aluminous or reinforced feldspathic porcelains, which have relatively poor strength but produce a strong structure when bonded to enamel. A study of veneers placed over a 6-year period in private practice reported only one failure, but as yet there are no clinical data making a direct comparison between these and the traditional materials.[6] The strength of traditional porcelain is generally adequate for anterior porcelain veneers is supported by a number of clinical studies. Some authors[6-8] have reported low rates of failure because of the loss of retention and fracture (0–5 %) with short and medium term studies of up to 5 years. Indeed, a long-term follow-up of veneers placed over a 10-year period shows a survival rate of 91 % at 10.5 years. These excellent results may, amongst other things, reflect careful case selection, but it is worth noting that other authors have reported much higher rates of failure of between 7–14 % over 2–5 years. Such studies suggest that the risk factors for veneer failure are:[8]

- Bonding onto pre-existing composite restorations
- Placement by an inexperienced operator
- Using veneers to restore worn or fractured teeth where a combination of parafunction, large areas of exposed dentine and insufficient tooth tissue exist.

Ceramics can be produced by different techniques, such as the traditional layering technique (veneered by condensing and sintering veneering porcelain), the fully anatomical technique (veneered by heat-pressing fluorapatite glass–ceramic ingots or CADCAM) or the cut-back technique (veneered by partial heat-pressing and subsequent layering). Different heat temperatures, pressing pressure or the sintering techniques can also influence the porcelain texture. The different interface textures between the porcelain layers can change the direction of incident light and further change the optical properties of the ceramic restoration. Whether different techniques have the same influence on the appearance of full-ceramic restorations has not been determined.[9]

Translucency is identified as one of the primary factors in controlling aesthetics and a critical consideration in the selection of materials. The optical properties of teeth and porcelains include color and translucency in addition to hue, value and chroma. All ceramic systems have various compositions with different crystalline contents, such as lithium disilicate, fluorapatite or leucite, which may affect the optical properties of these systems. An increase in the crystalline content to achieve greater strength generally results in greater opacity.[10]

To achieve a natural-looking restoration, two different steps need to be performed: select the best possible shade using a shade guide and/or an electronic shade-taking instrument, and reproduce this shade with an appropriate dental material. Shade selection is usually made by comparing the natural dental tissues with a shade guide. Although this color selection procedure has been the subject of several investigations, it is still considered to be the best and is therefore one of the weakest links in aesthetic restorative dentistry. Studies have compared the clinical performance of ceramics; however, the color compatibility of ceramic systems when constructing laminate veneers using different techniques and chemical structures is unknown. Establishing the correct match with the desired shade of the shade guide is still difficult. The durability of the color of the restorations may change after clinical use. In addition, only a few studies have focused on the optical properties of ceramics after ageing procedures, which is important for the long-term success of a restoration.[11]

Color properties of the tooth change exponentially when we go from enamel to dentin. Therefore to be able to get the best shade and contrast expected authors recommend staying in the enamel limits. The tooth preparation is desired to remain within enamel, so careful control of preparation depth is required. The enamel thickness differs from the incisal edge to the cervical margin. For this reason preparation depth will need to vary over the length of the tooth to avoid exposing dentine. The preparation depth should be 0.4 mm close to the gingival margin, growing to 0.7 mm towards the bulk of the preparation. This is best achieved by using a depth mark of some sort (depth guide bur). Formal depth grooves can be of limited value in this area as there is a tendency for the bur to catch and run into the groove when buccal reduction is being done. The alternative is to use depth pits prepared on the surface of the tooth using a 1mm diameter round bur put at half its diameter. The buccal surface reduction can then be undertaken to join the base of the pits. The reduction should mirror the natural curvature of the tooth in order to provide an even thickness of porcelain layer over the tooth surface, therefore should be in at least two planes. When the tooth in question is discolored, it is reasonable to proceed with a greater level of reduction to give the technician more chance to mask the stain beneath without over-contouring the tooth. This will have obvious disadvantages, as the preparation is likely to extend into dentine with greater depth of tooth reduction.[7]

Nattress et al[7] have demonstrated that even with experienced operators and careful control of cutting instruments there is a tendency for dentine to be exposed in the cervical and proximal regions of the preparations, where the enamel is thinnest. This should be borne in mind when deciding on the type of luting agent to be used in veneer placement. They also found that there was a tendency for variations in tooth preparation depth across their samples with least reduction in the mid-incisal region. There is no suggestion in the literature as yet that this causes any long-term damage to the tooth or affects the longevity of the veneer.

There are several ways of reduction required with the preparation: freehand, use of depth cuts/grooves (the use of depth cutters or grooves and dimples has been recommended to control tooth preparation, as the use of standardized objects allows accurate judgment of depth), and use of silicone putty index or the provisional (use of a silicone index derived from the wax-up allows a visualization of the reduction required to achieve the form and contours of the preplanned shape and length of the final veneers).[4]

Many studies suggest a 0.5 mm minimal thickness for tooth preparations for porcelain laminate veneers (PVL).[12] According to Nattress et al[7] freehand preparation can result in variable depth of preparation with dentin exposure. Ferrari et al[8] sectioned and measured the thickness of the labial enamel of 114 extracted incisor and premolar teeth at three sites, the gingival third, the middle third, and incisal third, with the results indicating that enamel thickness at the gingival third was 0.3–0.4 mm for incisor teeth. The authors argued that because the enamel should be reduced by 0.5 mm in a veneer preparation, this would result in dentin being exposed at the gingival margin, or alternatively, if the teeth are reduced less, an overcontoured restoration could result. Inadequate labial reduction can potentially lead to increased bulk in the veneer, whereas overreduction needlessly results in more extensive dentine exposure.[13-17] In cases in which the operator fails to achieve uniform reduction of the labial surface, taking account of the facial contours of the tooth, it is common to find areas of both inadequate and unnecessarily extensive reduction within the same preparation. Given the tendency to underprepare when teeth are prepared freehand, it is recommended that either an index or appropriate depth gauge bur be used when teeth are prepared for PLVs. Some freehand preparation of severely discolored teeth will still be required, so as to ensure a successful esthetic outcome, with an increased thickness of porcelain and/or luting cement in the final restoration having a greater masking ability.[18] Experienced, skilled ceramists have been able to create PLVs that are 0.3 mm thick. This ability has now allowed many dentists to become even more conservative in their preparation of teeth for PLV.

Hence there are limited studies demonstrating the adequacy of preparation depth between practitioners or prosthodontists. The aim of this study is to evaluate difference between a trained professional prosthodontist (PP) and a postgraduate prosthodontics student (PPS) in the preparation depth of laminate veneers using depth guide burs by scanning the tooth with a 3D scanner before and after the preparation.

The null hypothesis is, there will be a slight difference between PP and PPS in the term of laminate veneer preparation depth when using a depth guide bur.

MATERIALS AND METHODS

This project was approved by the Ethics Committee of Marmara University in Istanbul, Turkey (Application No:2016-89). In this study, 20 uniformed in size upper central incisor teeth were used. Care was taken so that there was no restoration or decay present. Hand tool cavitrons device (800 scaleX, Dentameri, California, USA) was used to clean plaque and then the teeth were stored in distilled water at room temperature. All teeth where selected so the mean inciso-cervical and mesio-distal length was 8 mm. Also for the teeth to be standardized the teeth did not have any caries, restorations or enamel defects.

Modeling wax (Cavex Set Up Soft Modelling Wax, Cavex, Haarlem, The Netherlands) was used to prepare 2 mm diameter cylinders. Then condensation silicone impression material (ZetaPlus, Zhermack, Rovigo, Italy) poured into prefabricated plastic molds with internal diameter of 5 mm and wax cylinder inserted. To fix the teeth in the silicone an orthodontic wire (Leowire round spring hard wire, Leowire, Firenze, İtaly) of 0.8 mm diameter was used. The teeth were marked 1 mm under the cementoenamel junction and a wax band was put around this line to ensure that the crown of the teeth were not submerged in acrylic. A paralelometer (Kavo EWL, Typ 990,Kavo Elektrotechnisches Werk GmbH, Leutkirch im Allgau, Germany) was used to ensure the tooth was embeded in the middle of the silicone mold. The fixed teeth were then placed above the silicone mold with the help of the paralelometer to ensure middle orientation.

Acrylic resin (Imicryl SC, Imicryl, Konya, Turkey) was poured into the silicone mold using the manufacturers' guidlines in 5/3.5 g ratio and after setting it was polished. The specimens were then seperated from the silicone mold and polished. The prepared specimens were then numbered and randomly allocated into 2 groups (Figure 1). To be able to compare the removed enamel 3 holes were drilled on the palatinal side of the tooth with a round bur (Komet, Gebr. Brasseler GmbH & Co, Lemgo, Germany) (Figure 2). Both clinicians' were assessed on 15 points of each tooth. The tooth was separated into the parts (incisal, middle and cervical) and then 5 points were randomly selected on the unprepared tooth.

Figure 1.

Distribution of teeth

Figure 2.

3 points opened on palatal surface

All teeth were scanned with the 3Shape D750 laser scanner (3 Shape A/S, Copenhagen, Denmark) after they were placed in acylic blocks. The three holes drilled on the palatinal aspect of the teeth were implemented so that after the preparation the teeth could be scanned again and there x,y,z axises could be aligned onto one another in a 3D modeling program Magics (Materialise NV, Belgium). The data would then in turn give us the amount of removed tissue from the preselected 15 points.

A digital dental caliper (Shan IP54, Guilin Measuring & Cutting Tool Works, Guilin, China) was used to measure a 1 mm distance to be able to mark the tooth for incisal reduction (Figure 3). 1mm incisal reduction was done using a chamfer bur (Komet, Gebr. Brasseler GmbH & Co, Lemgo, Germany) (Figure 4). The depth guide bur was used to give a depth of 0.5mm on the surface to prepare lines on the buccal aspect to standardize depth (Figure 5). After the preparation of the lines a lead pencil was used to paint their base on the buccal surface (Figure 6). All bases were then united using a champfer bur by holding the bur parallel to the tooth surface (Figure 7). The scan of the teeth was performed after the preparation had been completed and the superimposed portions were assessed. This in turn gave a 15 point assessment of the amount of the tissue removed.

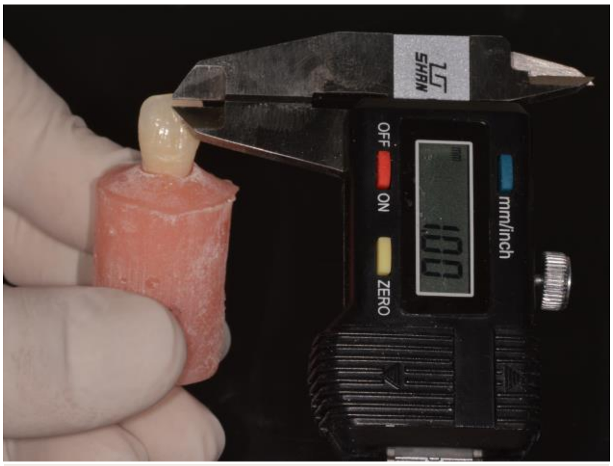

Figure 3.

Determination of incisal reduction by using a vernier caliper

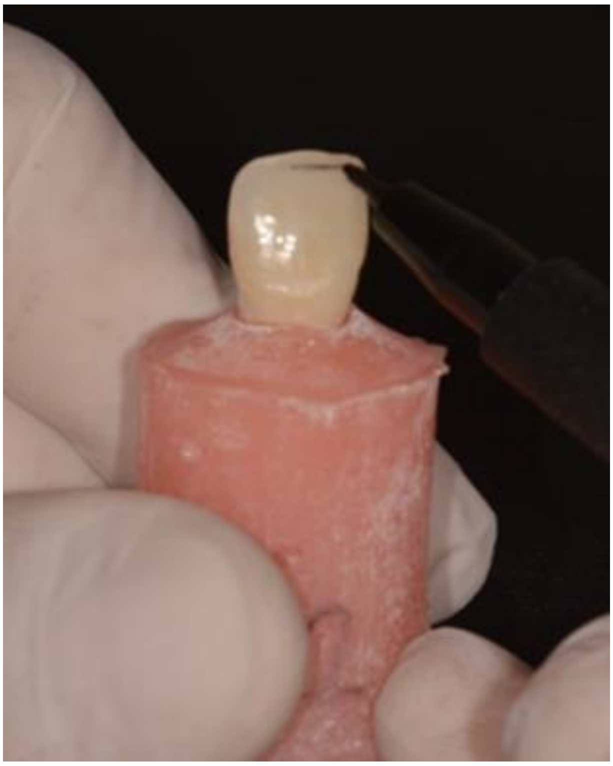

Figure 4.

Marking 1mm reduction

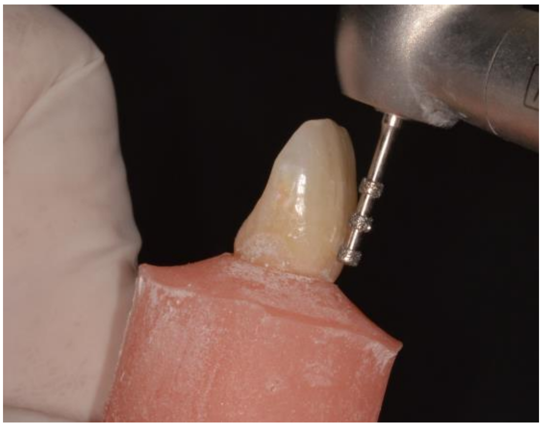

Figure 5.

Determination of buccal reduction by depth guided bur

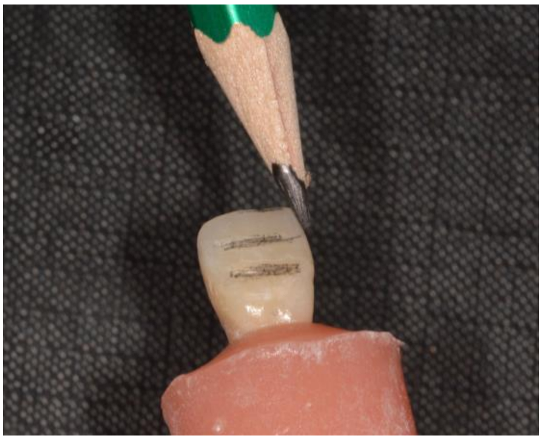

Figure 6.

Marking buccal reduction

Figure 7.

Final preparation

The teeth were scanned using ScanItOrthodontics™ program (3 Shape A/S, Copenhagen, Denmark) at accuracy of 10 microns (Figure 8). The before prep and after prep data was then sent to a coordinate plain where the virtual images were prompted to superposition. The superpositioned difference gave us the amount of total removed tooth tissue or the laminate thickness. Because of the three points opened on the palatinal surface there was very small room for error in the superpositioning process. The data of the difference found was then opened in a 3D scanning software (Magics, Materialise NV, Belgium) and was placed in the origin point after checking the x,y,z plains. The teeth were divided into three pieces being the incisal, middle and cervical portions. Five random points were then selected on all three surfaces (Figure 9). The points were not selected from the mesial or distal corners. By lapping the before and after data over one another on a x,y,z axis the amount of dental tissue removed on 15 points of the tooth was measured (Figure 10).

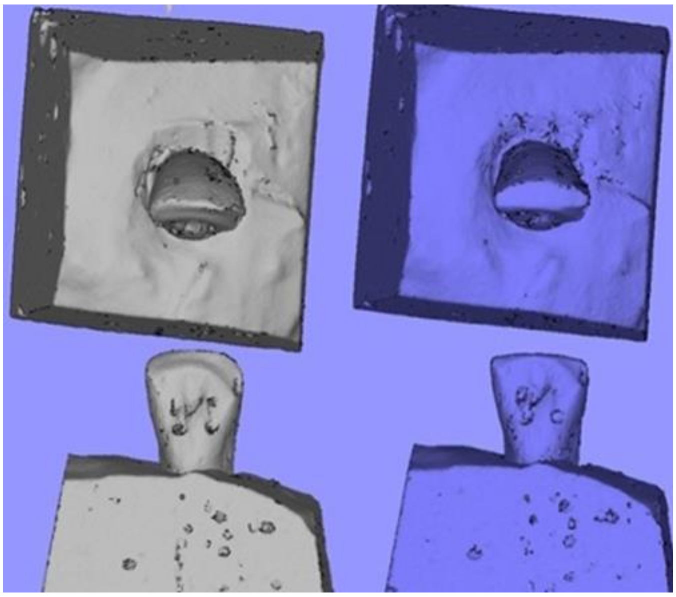

Figure 8.

The data of the difference found in 3D scanning

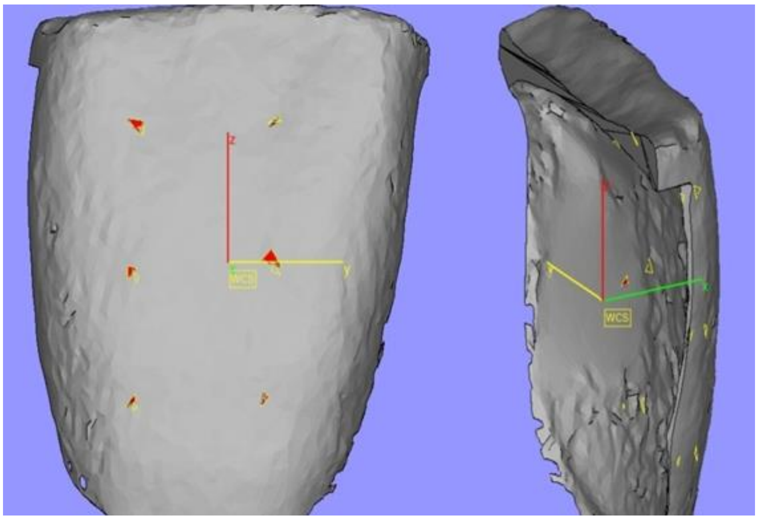

Figure 9.

Measurements on x,y and z axis

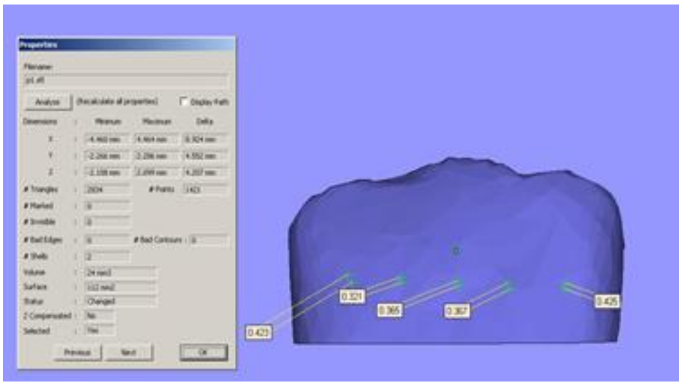

Figure 10.

Overlap of prepared and unprerapared teeth

Statistical analysis was performed with one-way ANOVA. Values of $P < 0.05$ were judged to be significant. SPSS 21 for windows (IBM SPSS Statistical Analysis, New York, USA) was used for statistical analysis.

RESULTS

The preparation data were analyzed in a digital environment and the amount of enamel which had been removed from the contact surface was found. The total amount of enamel volume which the bur had removed were found. The mean and standart deviations of the results were calculated (Table 1).

Table 1.

The mean and standart deviations of the results

Group PP	Mean± SD (mm)	Group PPS	Mean± SD(mm)
I1	0,3754±0.0844	I1	0,4345±0.1255
I2	0,2885±0.0596	I2	0,2785±0.0350
I3	0,2628±0.0673	I3	0,2616±0.0733
I4	0,2806±0.0735	I4	0,2866±0.0809
I5	0,4078±0.1065	I5	0,3779±0.0568
M1	0,4474±0.1519	M1	0,4787±0.1297
M2	0,367±0.0940	M2	0,3402±0.1086
M3	0,3185±0.0982	M3	0,3447±0.1169
M4	0,3751±0.1080	M4	0,3363±0.1111
M5	0,5084±0.0740	M5	0,3775±0.1075
C1	0,5009±0.1230	C1	0,5436±0.0523
C2	0,4203±0.0919	C2	0,4642±0.0760
C3	0,4118±0.1040	C3	0,4501±0.1128
C4	0,4739±0.0960	C4	0,4561±0.0954
C5	0,5058±0.0770	C5	0,4426±0.0785
Incisal	0,32302±0.05647	Incisal	0,32782±0.04498
Middle	0,40328±0.08306	Middle	0,37548±0.09725
Cervical	0,46254±0.07460	Cervical	0,47132±0.07142

The results for the PPS showed Incisal third values were section 1: minimum (min) of 0.305 mm, maximum (max) of 0.576 mm; section 2: min. 0.172 mm, max. 0.394 mm; section 3: min. 0.161 mm, max. 0.403 mm; section 4: min. 0.174 mm, max. 0.413 mm; section 5: min. 0.236mm, max. 0.549mm.

Results for PP in the Incisal third were section 1: min. 0.281 mm, max. 0.620 mm; section 2: min. 0.226 mm, max. 0.331 mm; section 3: min. 0.132 mm, max. 0.365 mm; section 4: min. 0.162 mm, max. 370 mm; section 5: min. 0.276 mm, max. 0.462 mm.

Results for PPS in the Middle third were section 1: min. 0.238 mm, max. 0.639 mm; section 2: min. 0.281 mm, max. 0.505 mm; section 3: min. 0.193 mm, max. 0.474 mm; section 4: min. 0.210 mm, max. 0.605 mm; section 5: min. 0.394 mm, max. 0.612 mm.

Results for PP in the Middle third were section 1: min. 0.328 mm, max. 0.747 mm; section 2: min. 0.202 mm, max. 0.489 mm; section 3: min. 0.184 mm, max. 0.513 mm; section 4: min. 0.202 mm, max. 0.545 mm; section 5: min. 0.220 mm, max. 0.590 mm.

Results for PPS in the Cervical third were section 1: min. 0.332 mm, max. 0.698 mm; section 2: min. 0.278 mm, max. 0.544 mm; section 3: min. 0.311 mm, max. 0.620 mm; section 4: min. 0.328 mm, max. 0.620 mm; section 5: min. 0.406 mm, max. 0.649 mm.

Results for PP in the Cervical third were section 1: min. 0.488 mm, max. 0.628 mm; section 2: min. 0.351 mm, max. 0.555 mm; section 3: min. 0.271 mm, max. 0.586 mm; section 4: min. 0.283 mm, max. 0.545 mm; section 5: min. 0.253 mm, max. 0.520 mm.

The incisal third results show significance values at 0.233 for I1, 0.653 for I2, 0.97 for I3, 0.864 for area 4 and 0.444 for I5. Given $p<0.05$ this indicates that the results between the PP and PPS have no significant difference. The middle third results show significance values at 0.626 for M1, 0.562 for M2, 0.594 for M3, 0.439 for M4 and 0.005 for M5. Given that $p<0.05$ this indicates that the results between the PP and PPS have no significant difference except for M5 which shows a significance of 0.005. The cervical third results show significance values at 0.326 for C1, 0.26 for C2, 0.441 for C3, 0.684 for C4 and 0.087 for C5. Given $p<0.05$ this indicates that the results between the PP and PPS have no significant difference.

Oneway Anova test was done on the data to determine if a significant difference would be found between the PP and the PPS. There were no significant differences between groups in all measured sections (Table 2, Table 3 and Table 4).

Table 2.

Results for incisal third (amount of removed dental tissue in mm)

Group	INCISAL 1/3					
	1	2	3	4	5	Mean
PP	0,335	0,35	0,281	0,243	0,433	0,3284
PP	0,305	0,294	0,249	0,328	0,327	0,3006
PP	0,329	0,272	0,279	0,238	0,528	0,3292
PP	0,466	0,297	0,314	0,317	0,456	0,37
PP	0,385	0,394	0,258	0,356	0,335	0,3456
PP	0,355	0,248	0,161	0,174	0,236	0,2348
PP	0,319	0,172	0,179	0,247	0,549	0,2932
PP	0,576	0,318	0,403	0,413	0,513	0,4446
PP	0,319	0,272	0,243	0,202	0,405	0,2882
PP	0,365	0,268	0,261	0,288	0,296	0,2956
PPS	0,46	0,251	0,132	0,162	0,42	0,285
PPS	0,589	0,305	0,283	0,37	0,323	0,374
PPS	0,281	0,226	0,245	0,324	0,367	0,2886
PPS	0,324	0,297	0,34	0,331	0,35	0,3284
PPS	0,381	0,251	0,271	0,232	0,276	0,2822
PPS	0,423	0,321	0,365	0,367	0,425	0,3802
PPS	0,296	0,288	0,26	0,368	0,405	0,3234
PPS	0,386	0,268	0,185	0,196	0,336	0,2742
PPS	0,585	0,331	0,331	0,318	0,415	0,396
PPS	0,62	0,247	0,204	0,198	0,462	0,3462

Table 3.

Results for middle third (amount of removed dental tissue in mm)

Group	MIDDLE 1/3					
	1	2	3	4	5	Mean
PP	0,562	0,283	0,291	0,397	0,557	0,418
PP	0,238	0,298	0,248	0,374	0,394	0,3104
PP	0,328	0,381	0,224	0,31	0,453	0,3392
PP	0,554	0,505	0,474	0,605	0,612	0,55
PP	0,258	0,398	0,348	0,374	0,454	0,3664
PP	0,598	0,469	0,439	0,364	0,58	0,49
PP	0,298	0,281	0,224	0,21	0,513	0,3052
PP	0,639	0,253	0,193	0,286	0,543	0,3828
PP	0,467	0,316	0,339	0,349	0,418	0,3778
PP	0,532	0,486	0,405	0,482	0,56	0,493
PPS	0,388	0,233	0,266	0,277	0,437	0,3202
PPS	0,543	0,384	0,276	0,282	0,22	0,341
PPS	0,453	0,216	0,239	0,249	0,3	0,2914
PPS	0,351	0,336	0,434	0,449	0,349	0,3838
PPS	0,328	0,29	0,258	0,202	0,29	0,2736
PPS	0,747	0,489	0,456	0,431	0,415	0,5076
PPS	0,467	0,316	0,339	0,349	0,418	0,3778
PPS	0,508	0,456	0,482	0,358	0,59	0,4788
PPS	0,614	0,48	0,513	0,545	0,459	0,5222
PPS	0,388	0,202	0,184	0,221	0,297	0,2584

Table 4.

Results for cervical Third (amount of removed dental tissue in mm)

Group	CERVICAL 1/3					
	1	2	3	4	5	Mean
PP	0,431	0,392	0,356	0,438	0,498	0,423
PP	0,454	0,367	0,344	0,347	0,489	0,4002
PP	0,338	0,278	0,338	0,506	0,475	0,387
PP	0,518	0,479	0,543	0,62	0,649	0,5618
PP	0,45	0,385	0,356	0,328	0,518	0,4074
PP	0,698	0,531	0,62	0,513	0,476	0,5676
PP	0,332	0,298	0,311	0,495	0,46	0,3792
PP	0,625	0,544	0,378	0,565	0,634	0,5492
PP	0,538	0,441	0,501	0,544	0,406	0,486
PP	0,625	0,488	0,371	0,383	0,453	0,464
PPS	0,522	0,401	0,43	0,494	0,516	0,4726
PPS	0,518	0,388	0,271	0,283	0,253	0,3426
PPS	0,492	0,555	0,54	0,515	0,474	0,5152
PPS	0,51	0,51	0,53	0,53	0,52	0,52
PPS	0,488	0,351	0,316	0,346	0,474	0,395
PPS	0,544	0,504	0,489	0,485	0,411	0,4866
PPS	0,605	0,542	0,52	0,506	0,448	0,5242
PPS	0,628	0,53	0,586	0,52	0,485	0,5498
PPS	0,614	0,48	0,513	0,545	0,459	0,5222
PPS	0,515	0,381	0,306	0,337	0,386	0,385

DISCUSSION

In the light of the results, the null hypothesis was rejected, no significant differences were found between difference between PP and PPS in the term of laminate veneer preparation depth when using a depth guide bur.

Central incisor teeth were commonly used for in vitro study because they have more enamel tissue then the lateral incisors and are more homogeneous than the canine tooth.[13,14] In this study central incisors were used for these reasons.

The materials used to support the tooth were selected so they would imitate the resilience of a natural tooth – periodontal ligament mobility.[4,19-21] In this study when preparing the acrylic blocks to support the tooth resilient models to mimic the periodontal ligament were not used. The reason for this is Castelnuovo et al's[5] finding that the force put on the coronal aspect of the tooth will not be diminished by the soft interface between the acrylic block and tooth.

In clinic studies such qualities as tooth dimension, shape, position, color and the patient's esthetic and functional expectations cause differences in procedure.[18,19,22,23] To standardize and limit the differences in application 0.5 mm enamel tissue was removed, a chamfer finish line was made and the marginal finish lines were restricted to the enamel to create an ideal preparation standard.

In this study homogeneous tooth dimensions were chosen, incizoservical, mesiodistal and labiopalatinal dimensions were measured and divided equally between the groups A and B. To make sure the restorations edges finished at the enamel the preparations on the incisal edge were reduced 1mm with a chamfer finish line. Special depth guide burs of 0.5mm were used in accordance with other studies showing that these guides needed to be done.[6,13,16]

Ferrari et al[8], in a study where they examined the enamel thickness of the anterior teeth on the cervical, middle and incisal surface, in measurements up to 2 mm above the cementoenamel junction 0.4mm enamel thickness was reported for central incisors and 0.3mm was reported for lateral incisor teeth. The enamel thickness in the incisor teeth were reported as, 0.3-0.5 mm cervical area, 0.6-1.0 mm middle area and 1.0-2.1 mm on the incisal third. In our study the preparations depths on the enamel surfaces were in accordance to this study where the maximum preparation depth on the incisal surface was 0.62mm, on the middle surface the maximum was 0.747 and the cervical surface the maximum value was 0.698 which was 0.198 over the maximum limit shown by Ferrari.

There have been different opinions on the incisal edge reduction technique for laminate veneer preparations in literature.[13,20,24-27] Hahn et al[14] and Hui et al[15], found incisal preparation that didn`t include the incisal edge to be superior than overlap preparation technique.

Castelnuovo et al[5], however found that overlap preparation technique was superior in terms of force distribution and resistance. In our study we preferred preparation with a 1 mm incisal edge reduction without overlap because the study is focused on the volume of dental tissue removed on the buccal surface therefore the incisal overlap is irrelevant.

Troedson et al[21], compared “feathered”, “chamfer” and “shoulder” finish lines in porcelain laminate veneer restorations and concluded that the finish lines should either be “shoulder” or “chamfer” finish design. In our study “chamfer” finish line was preferred and the finish line was 1mm above the cementoenamel junction.

Nattress et al[7], concluded that for a homogeneous preparation a depth guide cut must be used. In our study preparation was depth guide burs were used for this reason and a reduction of 0,32$\pm$0.06 was found fort he PPS in the Incisal third, 0,40$\pm$0.08 for the Middle third, and 0,46$\pm$0.07 in the Cervical third, whereas the results fort he PP were 0,33$\pm$0.04 for Incisal third, 0,38$\pm$0.10 for Middle third and 0,47$\pm$0.07 for Cervical third.

Cherukara et al[6] studied the geographical distribution and depth of a porcelain veneer preparation. One clinician used 3 different techniques, (using a round bur points for depth guide, free-hand preparation and using a depth guide groove) 90 laminate veneer preparations were done. Impressions were taken and then scanned by a coordinate measurement machine. As a result the group that used a 1mm round bur for depth guide gave more certain results. In our study we used 1mm depth guide grooves for determining depth of preparation so that more homogeneous preparations could be obtained. Geographical analysis showed a great deal of detail on how much tissue was removed from the surface and was also accurate in this term. Therefore in our study we used a similar method of geographical analysis to show the removed tissue amount. A 3D scanner was used to determine the amount of removed tissue.

In this study we hypothesized that even with a depth guide bur that helps keep in the recommended range of preparation depth that a professional prosthodontist and a postgraduate student would have significantly different outcomes in preparation depth. Our findings showed that out of a total of 100 points examined 1 point was found to have a significant difference among the two physicians which in turn if a $p<0.05$ is used means in overall no significant difference was found between the two physicians.

CONCLUSION

In this in vitro study we concluded that with a depth guide bur a trained physician can attain a preparation depth which is in the adequate norms. Furthermore a professional prosthodontist and a postgraduate prosthodontic student could attain within adequate norms the same preparation with the help of depth guide burs.

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